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CGSB Standard

Aviation turbine fuel (Military grades F-34, F-37 and F-44)

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Aviation turbine fuel (Military grades F-34, F-37 and F-44)

1 Scope

This standard applies to three grades of aviation turbine fuel (military grades F-34, F-37 as its equivalent, and F-44) consisting of conventional hydrocarbons, synthetic hydrocarbons, naturally occurring non-hydrocarbons and additives as specified herein.

Grade F-34 is a kerosene-type aviation turbine fuel, and grade F-44 is a high-flash kerosene-type aviation turbine fuel. Kerosene-type aviation turbine fuels are distillates with a minimum flash point of 38°C and high-flash type aviation turbine fuels are distillates with a minimum flash point of 60°C. Grade F-37 is equivalent to grade F-34 with the addition of an approved thermal stability additive.

This standard describes three military grade fuels normally used in aviation and naval operations whose product quality parameters are influenced by international military standardization agreements. F-34, F-37 and F-44 are NATO code numbers for products conforming to this standard.

Limitations for use — Aircraft operators should consult their aircraft manuals for the type of fuel, fuel additives or other limitations.

The testing and evaluation of a product against this standard may require the use of materials and/or equipment that could be hazardous. This document does not purport to address all the safety aspects associated with its use. Anyone using this standard has the responsibility to consult the appropriate authorities and to establish appropriate health and safety practices in conjunction with any applicable regulatory requirements prior to its use.

2 Normative references

The following normative documents contain provisions that, through reference in this text, constitute provisions of this CGSB Standard. The referenced documents may be obtained from the sources noted below.

NOTE The addresses provided below were valid at the date of publication of this standard.

An undated reference is to the latest edition or revision of the reference or document in question, unless otherwise specified by the authority applying this standard. A dated reference is to the specified revision or edition of the reference or document in question.

2.1 Canadian General Standards Board (CGSB)

CAN/CGSB-3.524 — *Biodiesel (B100) for blending in middle distillate fuels.*

2.1.1 Source

The above may be obtained from the Canadian General Standards Board, Sales Centre, Gatineau, Canada K1A 1G6. Telephone 819-956-0425 or 1-800-665-2472. Fax 819-956-5740. E-mail ncr.cgsb-ongc@tpsgc-pwgsc.gc.ca. Web site www.tpsgc-pwgsc.gc.ca/ongc-cgsb/index-eng.html.

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2.2 ASTM International

Annual Book of ASTM Standards (see Annex A).

2.2.1 Source

The above may be obtained from ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, U.S.A., telephone 610-832-9585, fax 610-832-9555, Web site www.astm.org, or from IHS Markit, 200-1331 MacLeod Trail SE, Calgary, Alberta T2G 0K3, telephone 613-237-4250 or 1-800-267-8220, fax 613-237-4251, Web site www.global.ihs.com.

2.3 Energy Institute (EI)

IP 540 — *Determination of the existent gum content of aviation turbine fuel — Jet evaporation method*

IP 583 — *Determination of the fatty acid methyl esters content of aviation turbine fuel using flow analysis by Fourier transform infrared spectroscopy — Rapid screening method*

IP 585 — *Determination of fatty acid methyl esters (FAME), derived from bio-diesel fuel, in aviation turbine fuel — GC-MS with selective ion monitoring/scan detection method*

IP 590 — *Determination of fatty acid methyl esters (FAME) in aviation turbine fuel — HPLC evaporative light scattering detector method*

IP 599 — *Determination of fatty acid methyl esters (FAME) in aviation turbine fuel — Gas Chromatography using heart-cut and refocusing.*

2.3.1 Source

The above may be obtained from the Energy Institute, 61 New Cavendish Street, London, England W1G 7AR, UK, telephone +44 (0)20-7467-7100, fax +44 (0)20-7255-1472, email pubs@energyinst.org.uk, Web site www.energyinst.org.uk.

2.4 European Committee for Standardization (CEN)

EN 14214 — *Liquid petroleum products — Fatty acid methyl esters (FAME) for use in diesel engines and heating applications — Requirements and test methods.*

2.4.1 Source

The above may be obtained from BSI Shop at http://www.bsigroup.com/.

2.5 U.S. Department of Defense

MIL-PRF-25017 — *Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble*

QPL-25017 — *Qualified Products List of Products Qualified Under Performance Specification MIL-PRF-25017 Inhibitor, Corrosion/Lubricity Improver, Fuel Soluble.*

2.5.1 Source

The above may be obtained from Document Automation and Production Service, 700 Robbins Avenue, Building 4/D, Philadelphia, PA 19111-5094, U.S.A. Fax 215-697-1462, Web site http://quicksearch.dla.mil/

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3 Classification

3.1 The aviation turbine fuel shall be classified in the following grades (see 8.1).

3.1.1 Grades

F-34

F-37

F-44.

4 General fuel requirements

4.1 Conventional hydrocarbons shall be predominantly petroleum-derived from natural gas liquid condensates, crude oil and heavy oil including bitumen from oil sands.

4.2 Synthetic hydrocarbons shall consist predominantly of hydrocarbons derived from non-petroleum sources such as biomass, natural gas, coal, fats and oils by processes such as gasification, reforming, Fischer-Tropsch synthesis, hydroprocessing or hydrocracking.

4.2.1 Synthetic hydrocarbons are only permitted in jet fuel in a blend with conventional hydrocarbons. The synthetic blending component shall meet the requirements of ASTM D7566. Once a batch of aviation turbine fuel containing synthetic hydrocarbons is manufactured, blended and released to the specifications of CGSB-3.24 then the extended requirements specified in 5.14 are no longer applicable. Any re-testing shall be done to the requirements of CGSB-3.24, excluding 5.14.

4.3 The fuel shall be visually clear and free from undissolved water and particulate matter.

4.4 The odour of the fuel should not be nauseating or irritating.

5 Detailed requirements

5.1 The detailed requirements shall apply to the fuel unless otherwise specified.

5.2 Except as described in 4.2.1, the fuel shall comply with the detailed requirements specified in 5.4 to 5.13, using the test methods indicated. The specified limiting values shall not be changed. This precludes any allowances for test method precision and adding or subtracting digits.

5.2.1 A batch of fuel which includes synthetic hydrocarbons shall also comply with 5.14 the first time it is tested for compliance with this specification.

5.3 To determine conformance with the specified limiting values, an observed value or a calculated value shall be "rounded off to the nearest unit" in the last right-hand digit used in expressing the specified limiting values, in accordance with the rounding-off method of ASTM E29. Zeroes trailing the last nonzero digit for numbers represented with a decimal point are significant digits, in accordance with ASTM E29.There are two exceptions (see 5.5.1 and 5.5.4) that shall be reported to the nearest 0.5°C.

5.3.1 Where test values differ between two parties, a resolution shall be in accordance with ASTM D3244 in order to determine conformance with the specified limiting values, with the criticality of the limits set as $P = 0.5$.

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	Property	Specified limiting values				
		F-34 and F-37		F-44		Test method
		Min.	Max.	Min.	Max.	ASTM
5.4	Composition					
5.4.1	Acidity, total, mg KOH/g	—	0.10	—	0.03	D3242
5.4.2	Aromatics, % by volume	—	25	—	25	D1319[a]
		—	26.5	—	25	D6379
5.4.3	Sulphur, total, % by mass (see 5.15)	—	0.30	—	0.30	D2622, D4294[a], D5453 or D7039 (see 5.15)
5.4.4	Sulphur, mercaptan[b],					
	a) % by mass or	—	0.003	—	0.002	D3227
	b) Doctor test	negative		negative		D4952
5.5	Volatility					
5.5.1	Distillation temperature, °C					D86[a] or D2887[c]
	a) Initial boiling point	Report		Report		
	b) 10% recovered (T10)	—	205	—	205	
	c) 20% recovered (T20)	Report		Report		
	d) 50% recovered (T50)	Report		Report		
	e) 90% recovered (T90)	Report		Report		
	f) Final boiling point	—	300.	—	300.	
5.5.2	Residue[d], % by volume	—	1.5	—	1.5	D86
5.5.3	Loss[d], % by volume	—	1.5	—	1.5	D86
5.5.4	Flash point, °C	38	—	—	—	D56[a] or D3828[e]
		—	—	60.	—	D93
5.5.5	Density at 15°C, kg/m^3	775	840.	788	845	D1298[a] or D4052
5.6	Fluidity					
5.6.1	Freezing point, °C	—	-47	—	-46	D2386[f] or D5972[a]

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	Property	Specified limiting values				
		F-34 and F-37		F-44		Test method
		Min.	Max.	Min.	Max.	ASTM
5.6.2	Kinematic viscosity[g] at -20°C, mm^2/s	—	8.0	—	8.8	D445[a] or D7042[h]
5.7	Combustion					
5.7.1	a) Smoke point, mm or	25	—	19	—	D1322
	b) Smoke point, mm and	18	—	—	—	D1322
	Naphthalenes, % by volume	—	3.0	—	—	D1840
5.7.2	Hydrogen content	—	—	Report		D3343 or D3701[a]
5.7.3	Net heat of combustion, MJ/kg	42.8	—	42.6	—	D3338[i], D4529[i], or D4809[a]
5.8	Corrosion (see 6.6 and 9.5)					
5.8.1	Copper strip corrosion, 2 h at 100 °C	—	No. 1	—	No. 1	D130
5.9	Thermal stability[j] (see 9.2.2)					
5.9.1	Filter pressure drop, mm Hg	—	25	—	25	D3241
5.9.2	Tube deposit, a, b or c					
	a) Tube deposit (visual)	Less than 3		Less than 3		D3241[a]
	b) Tube deposit (ITR), nm average over area of 2.5 mm^2	—	85	—	85	D3241 Annex A2
	c) Tube deposit (ETR), nm average over area of 2.5 mm^2	—	85	—	85	D3241 Annex A3
5.9.3	Visual examination, on the heater tube, darkest deposits	No peacock (rainbow) or abnormal colour deposits				D3241
5.10	Contaminants (see 9.6)					
5.10.1	Existent gum, mg/100 mL	—	7	—	7	D381[a] (steam jet) or Energy Institute IP 540 (air or steam jet)

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	Property	Specified limiting values				
		F-34 and F-37		F-44		Test method
		Min.	Max.	Min.	Max.	ASTM
5.10.2	Particulate matter, mg/L at time of delivery to					D2276 or D5452[k]
	a) Purchaser's storage	—	2.2	—	2.2	
	b) Aircraft and refuellers	—	0.44	—	0.50	
5.11	Water separation characteristics; if static dissipator additive is used, then the limits apply after addition (see 6.2) (see 9.4) Micro-separometer[l], a) or b):					
	a)	85	—	85	—	D7224[a]
	b)	70.	—	70.	—	D3948
5.12	Electrical conductivity (see 6.2)					
5.12.1	At point, time and temperature of use[m], pS/m	50.	600.	—	600.	D2624
5.13	Additives (see 9.5)					
5.13.1	Static dissipater additive (see 6.2), mg/L					
	a) Original addition	—	3	—	3	—
	b) Cumulative	—	5	—	5	—
5.13.2	Antioxidant (see 6.3), mg/L					
	a) Hydrogen-processed[n] portion	17.2	24	17.2	24	—
	b) Non-hydrogen-processed portion, Optional	—	24	—	24	—
5.13.3	Metal deactivator (see 6.4), mg/L, Optional	—	5.7	—	5.7	—
5.13.4	Fuel system icing inhibitor (see 6.5), % by volume	0.10	0.15	0.10	0.15	D5006

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	Property	Specified limiting values				
		F-34 and F-37		F-44		Test method
		Min.	Max.	Min.	Max.	ASTM
5.13.5	Corrosion inhibitor/lubricity improver (see 6.6)	concentration limits as specified in QPL-25017		concentration limits as specified in QPL-25017		—
5.13.6	Leak detection additive (see 6.7), mg/kg Optional	—	1	—	1	—
5.14	Extended requirements for fuels containing synthetic hydrocarbons [o] (see 4.2.1)					
5.14.1	Synthetic hydrocarbon content [p], % by volume	—	50.	—	50.	—
5.14.2	Aromatics [q], % by volume					
	a) or	8	—	8	—	D1319 [a]
	b)	8.4	—	8.4	—	D6379
5.14.3	Distillation temperature differences [r], °C					D2887 [c] or D86 [a]
	a) T50-T10	15	—	15	—	
	b) T90-T10	40.	—	40.	—	
5.14.4	Lubricity, at point of manufacture, mm (see 9.1)	—	0.85	—	0.85	D5001

[a] In the event of a dispute, this method shall be the referee method.

[b] The mercaptan sulphur determination may be waived if the fuel is considered "sweet", and received a negative result by the doctor test described in ASTM D4952.

[c] When testing in accordance with ASTM D2887, apply the relevant Annex to convert distillation temperature results to estimates of ASTM D86 results.

[d] If ASTM D2887 is used to determine distillation temperature (see 5.5.1), then residue and loss requirements shall not apply because no residue or loss results from the application of ASTM D2887.

[e] The results obtained by ASTM D3828 can be up to 2°C lower than those obtained by ASTM D56, which is the referee method.

[f] CAUTION: Results from two extensive round-robin tests reported in ASTM Research Reports 1536 and 1572 demonstrated that the manual freezing point test ASTM D2386 could only detect heavy material contamination (e.g. diesel fuel) in JET A-1 fuel (equivalent to F-34 and F-44 fuels) in less than half of the cases tested, whereas the automatic freezing point test ASTM D5972 was effective at detecting such contamination in all cases tested.

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[g] The SI unit for kinematic viscosity is the square metre per second. The preferred multiple for fluids in this viscosity range is the square millimetre per second, which is equivalent to a centiStokes (i.e., 1 mm^2/s =1 cSt).

[h] Only bias-corrected values from ASTM D7042 shall be used as an alternate to ASTM D445.

[i] Calculate and report the net heat of combustion corrected for the sulphur content when using these empirical test methods.

[j] Thermal stability shall be determined using the Jet Fuel Thermal Oxidation Tester at a minimum heater-tube-controlled temperature of 260°C. The SI unit equivalent for the pressure differential is 3.3 kPa. However, the Jet Fuel Thermal Oxidation Tester gives the results in mm Hg, and 25 mm Hg is the exact maximum.

[k] ASTM D2276 and D5452 refer to different sampling procedures. In some situations it may not be practical to sample according to D2276; however, when results are obtained by both methods, D2276 shall be considered the referee method.

[l] The minimum micro-separometer (MSEP) rating applies from the point of manufacture to the point immediately before the fuel enters dedicated transportation to military storage. MSEP by ASTM D7224 can be useful in determining the water separation characteristics of a batch of jet fuel even when additized with static dissipator additive and certain other additives that do not actually degrade water separation performance in coalescing separators. When the fuel enters dedicated transportation to military storage, or when the fuel is already in military storage, the MSEP rating requirement shall not apply. When a corrosion inhibitor/lubricity improver (see 6.6) is added, the MSEP limits apply before its addition. For clarity MSEP results shall be reported by test method (i.e. MSEP by ASTM D3948 or MSEP by ASTM D7224).

[m] Conductivity often drops during fuel distribution due to additive depletion and lower temperatures, so it is common practice to initially additize at the upper end of the conductivity range.

[n] Hydrogen-processing is any petroleum refining process that uses hydrogen in the presence of a catalyst.

[o] The synthetic hydrocarbon content, aromatics, distillation slope, and lubricity criteria only apply to aviation turbine fuels produced to this specification that contain synthetic hydrocarbons. The criteria do not apply to aviation turbine fuels produced to CGSB-3.24 specifications from conventional hydrocarbons and that do not contain synthesized hydrocarbons. The criteria are also not applicable to aviation turbine fuels containing synthesized hydrocarbons after the fuels have been manufactured, blended and released to CGSB-3.24.

[p] The synthetic hydrocarbon content of the blend shall be calculated from metered (measured) volumes used to prepare the blend. As listed in ASTM D7566, lower maximum limits associated to specific synthetic components shall apply.

[q] Minimum aromatics content limits are based on current experience with synthetic fuels, and these values were established from what is typical for jet fuel produced from conventional hydrocarbons.

[r] The distillation slope limits are based on current experience with synthetic fuels, and these values were established from what is typical for jet fuel produced from conventional hydrocarbons.

5.15 Sulphur

The accuracy of ASTM D7039 for the sulphur content of jet fuel beyond 2822 mg/kg has not been validated. Users are cautioned to conduct their own validation when using this test method for jet fuel containing more than 2822 mg/kg sulphur.

6 Additive requirements

6.1 Only the additives listed in 6.2 to 6.7 may be added to the fuel. Refer to 5.13 for specified limiting values and test method for each property. The supplier shall record the amount and names of each additive added to the fuel.

6.1.1 The amount of each additive used in the fuel shall be determined by the test method (see 5.13 and 9.5) or by volume reconciliation. Procedures for volume reconciliation should include recording the volume of additive introduced to the fuel and the volume of fuel additized in appropriate units.

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6.2 Static dissipater additive

6.2.1 Static dissipater additive (SDA) STADIS® 450[1] shall be added to the fuel when necessary to meet the electrical conductivity requirements specified in 5.12.1. The original concentration of the SDA shall not exceed 3 mg/L.

6.2.2 When additive depletion is evident by a conductivity loss, further addition of the SDA is permitted as follows:

— If the original concentration of the SDA is not known, then an original addition of 3 mg/L is assumed and further addition of SDA shall not exceed 2 mg/L.

— The cumulative concentration of the SDA shall not exceed 5 mg/L.

6.2.3 Electrical conductivity varies with temperature. A typical relationship follows:

$$\log k_t = a(t - t_1) + \log k_{t_1}$$

where:

k_t = electrical conductivity at temperature t, °C

k_{t_1} = electrical conductivity at temperature t_1, °C

a = a factor that depends on fuel composition but normally is within the range 0.013 to 0.018 for kerosene-type aviation turbine fuels

6.2.3.1 The temperature-conductivity factor, , increases at or below an approximate temperature of -10°C. For conductivity at very low temperatures, it is recommended that a separate factor be determined based on actual measurements at the lowest temperatures that are assumed will be encountered. For more information on how low temperature affects conductivity, see the relevant Appendix of ASTM D2624.

6.3 Antioxidants

6.3.1 The addition of antioxidants is mandatory for the hydrogen-processed portion of the fuel, but optional for the non-hydrogen-processed portion of the fuel (see 5.13.2).

6.3.2 Only the following antioxidants may be added separately or in combination to the fuel. The total concentration (not including mass of solvent) shall not exceed 24 mg/L.

a) 2,6-di-*tert*-butylphenol

b) 2,6-di-*tert*-butyl-4-methylphenol

c) 2-*tert*-butyl-4,6-dimethylphenol (2,4-dimethyl-6-tertiary butylphenol)

d) 75% minimum, 2,6-di-*tert*-butylphenol

25% maximum mixture of *tert*- and tri-*tert*-butylphenols

[1] STADIS® 450, a registered trademark of Innospec Fuel Specialties LLC, is manufactured in the United States and distributed globally by Innospec Fuel Specialties LLC.

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e) 55% minimum, 2-*tert*-butyl-4, 6-dimethylphenol (2,4-dimethyl-6-tertiary butylphenol)

15% minimum, 2,6-di-*tert*-butyl-4-methylphenol

Remainder as methyl and dimethyl *tert*-butylphenols

f) 72% minimum 2-*tert*-butyl-4,6-dimethylphenol (2,4-dimethyl-6-tertiary butylphenol)

28% maximum, methyl and dimethyl *tert*-butylphenols.

NOTE The names of the antioxidants conform to the International Union of Pure and Applied Chemistry (IUPAC) naming convention. In some cases, the common name of the antioxidant has been included in brackets after the IUPAC name.

6.4 Metal deactivator additive (MDA)

Only N,N'-disalicylidene-1,2-propane-diamine may be added as a metal deactivator at a concentration not exceeding 2.0 mg/L (not including mass of solvent) on the initial fuel manufactured at the refinery. Higher concentrations are permitted in circumstances where copper contamination is suspected to occur during distribution. Cumulative concentration of metal deactivator when re-treating the fuel shall not exceed 5.7 mg/L (see 9.2).

6.5 Fuel system icing inhibitor

A fuel system icing inhibitor conforming to ASTM D4171 (Type III [DIEGME]) shall be added to the fuel within the limits specified in 5.13.4.

6.6 Corrosion inhibitors/lubricity improvers

A corrosion inhibitor/lubricity improver qualified to U.S. Military Specification MIL-PRF-25017 and listed in the associated qualified product list (QPL) 25017 shall be added to the fuel (see 9.1). The concentration of the additive in the fuel shall be as specified in the QPL, and its introduction into the fuel shall be separate from the addition of other additives.

6.7 Leak detection additive[2]

Only Tracer A (LDTA-A®)[3] may be added as a leak detection additive. The maximum concentration is 1 mg/kg.

6.8 Thermal stability additive

Only the following thermal stability additives may be blended with F-34 at the following concentrations to make F-37 fuel grade:

a) SPEC AID 8Q462W™[4] at 256 mg/L of fuel.

b) BASF Kerojet™[5] 100W at 294 mg/L of fuel.

NOTE These additives shall be used discretely and not mixed together in F-37.

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[2] The Tracer Tight methodology to detect and locate leaks in ground-based fuel storage, delivery and dispensing systems does not form part of this standard. Refer to the additive supplier for this information. Praxair Services, Inc. can be contacted at 3755 N. Business Center Drive, Tucson, AZ 85705, U.S.A., telephone 1-800-989-9929, web site www.praxair.com.

[3] Tracer A (LDTA-A®) is a registered trademark of Praxair Services, Inc.

[4] SPEC AID 8Q462W is a registered trademark of GE Power & Water Process Technologies

[5] BASF Kerojet is a registered trademark of BASF.

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7 Inspection

A sample of the size specified by the testing authority shall be obtained in accordance with ASTM D4057. For automatic sampling ASTM D4177 shall be used. Sample volume should be consistent with the requirement of the testing laboratory, the authority having jurisdiction or both.

8 Option

8.1 The following option shall be specified in the application of this standard:

a) Grade F-34, Grade F-37 or Grade F-44 (see 3.1).

9 Precautions

9.1 Lubricity information statement

9.1.1 Lubricity, which is the ability of jet fuel to act as a lubricant for certain aircraft fuel-wetted components, can vary considerably. It depends on the design, materials used and the intrinsic lubricity of the fuel. There have been a number of cases of engine hardware failures directly attributed to poor-lubricity fuel.

9.1.2 ASTM D5001 may be used to determine the lubricity quality of the fuel. This standard does not require the measurement of fuel lubricity except in the case of fuels containing synthetic hydrocarbons (see 5.14.4). Hydrogen-processing[6] usually produces fuels with poor lubricity. Blending or commingling with non-hydrogen-processed fuels will improve lubricity, and the use of lubricity-improver additives (corrosion inhibitors) may offer a solution (see 6.6).

9.1.3 Problems are more likely to occur when aircraft operations are confined to a single refinery source where fuel is severely hydrogen-processed and where there is no commingling with fuels from other sources during distribution between refinery and the aircraft.

9.2 Copper information statement

9.2.1 The contamination of jet fuel can occur during manufacture or during distribution in marine vessels with copper coils, and from the copper-alloy components and fittings in sampling points.

9.2.2 Trace levels of copper, in the parts per billion range, can be sufficient to degrade the ASTM D3241 Jet Fuel Thermal Oxidation Tester test result. Where the possibility of copper pickup is suspected, an approved metal deactivator as specified in 6.4 may be added to preserve or restore the thermal stability of the fuel, or both. Note that ASTM D6732 can be used to measure the level of copper in jet fuel.

9.3 Colour information statement

While this standard does not have a colour requirement, colour may be a useful indicator of fuel quality or contamination. Normally fuel colour ranges from water white (colourless) to a pale straw yellow. Other fuel colours can be the result of crude oil characteristics or refining processes. Darkening of fuel or a change in fuel colour can be the result of product contamination and can indicate that the fuel is off-specification, which could render it unfit and not acceptable for aircraft or engine use, or both. Fuel having various shades of colour, that is, pink, red, green, blue, or a change in colour from the supply source should be investigated to determine the cause of the colour change to ensure suitability for aircraft or engine use, or both.

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[6] Hydrogen-processing is any petroleum refining process that uses hydrogen in the presence of a catalyst.

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9.4 Water separation characteristic information statement

The ease of coalescence of water from fuels as influenced by surface-active agents (surfactants) may be assessed by ASTM D7224 or D3948. A high water separation characteristic rating suggests a fuel free of surfactants, whereas a low rating indicates the presence of surfactants. Surfactants can disarm coalescers, thus allowing water to pass through coalescer filters and remain in the fuel. Surfactants can be introduced into the fuel downstream from a refinery distribution system, in storage facilities or deliberately introduced through the addition of specific approved additives. In light of the factors that can degrade water separation characteristics, options such as supplying higher water separation characteristics than the minimum specification should be considered at the point of origin depending upon the means of distribution.

9.5 Refinery processing additive information statement

Additives used in refinery processes, such as corrosion inhibitors, can be carried over in trace quantities into aviation fuel. In a few isolated cases this has resulted in operational problems in aircraft fuel systems. Moreover, the tests and requirements specified in this standard may not be sufficient for detecting trace levels of refinery processing additives. It is therefore recommended that adequate quality assurance and management of change procedures, such as formal risk assessments, be in place to ensure that any relevant refinery processing additive use is well defined and controlled in order to maintain the quality of the finished product.

9.6 Contaminants — Incidental materials — Biodiesel information statement

Biodiesel (Fatty Acid Methyl Esters or FAME) is not an approved component in aviation turbine fuels. The use of FAME in other fuels has raised concern about contamination of aviation turbine fuels, particularly in non-dedicated distribution systems such as multi-product pipelines, marine vessels, railcars and tanker trucks.

The amount of incidental FAME (as defined by ASTM D6751, CAN/CGSB-3.524 or EN 14214) shall not exceed 50 mg/kg. Producers, distributors and users need to take appropriate precautions to avoid contamination. The supplier shall establish the need to test for FAME based on various risk factors that can lead to FAME contamination. Suitable test methods for determining the concentration of FAME in aviation turbine fuels are ASTM D7797/IP 583, IP 585, IP 590 and IP 599. In the event of a dispute, IP 585 shall be the referee method.

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Annex A
(normative)

Referenced ASTM International publications (see 2.2)

Annual Book of ASTM Standards

ASTM D56	Standard Test Method for Flash Point by Tag Closed Cup Tester
ASTM D86	Standard Test Method for Distillation of Petroleum Products at Atmospheric Pressure
ASTM D93	Standard Test Methods for Flash-Point by Pensky-Martens Closed Cup Tester
ASTM D130	Standard Test Method for Corrosiveness to Copper from Petroleum Products by Copper Strip Test
ASTM D381	Standard Test Method for Gum Content in Fuels by Jet Evaporation
ASTM D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
ASTM D1298	Standard Test Method for Density, Relative Density (Specific Gravity), or API Gravity of Crude Petroleum and Liquid Petroleum Products by Hydrometer Method
ASTM D1319	Standard Test Method for Hydrocarbon Types in Liquid Petroleum Products by Fluorescent Indicator Adsorption
ASTM D1322	Standard Test Method for Smoke Point of Kerosine and Aviation Turbine Fuel
ASTM D1840	Standard Test Method for Naphthalene Hydrocarbons in Aviation Turbine Fuels by Ultraviolet Spectrophotometry
ASTM D2276	Standard Test Method for Particulate Contaminant in Aviation Fuel by Line Sampling
ASTM D2386	Standard Test Method for Freezing Point of Aviation Fuels
ASTM D2622	Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry
ASTM D2624	Standard Test Methods for Electrical Conductivity of Aviation and Distillate Fuels
ASTM D2887	Standard Test Method for Boiling Range Distribution of Petroleum Fractions by Gas Chromatography
ASTM D3227	Standard Test Method for (Thiol Mercaptan) Sulfur in Gasoline, Kerosine, Aviation Turbine, and Distillate Fuels (Potentiometric Method)
ASTM D3241	Standard Test Method for Thermal Oxidation Stability of Aviation Turbine Fuels (JFTOT Procedure)
ASTM D3242	Standard Test Method for Acidity in Aviation Turbine Fuel
ASTM D3244	Standard Practice for Utilization of Test Data to Determine Conformance with Specifications
ASTM D3338	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D3343	Standard Test Method for Estimation of Hydrogen Content of Aviation Fuels

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ASTM D3701	Standard Test Method for Hydrogen Content of Aviation Turbine Fuels by Low Resolution Nuclear Magnetic Resonance
ASTM D3828	Standard Test Methods for Flash Point by Small Scale Closed Cup Tester
ASTM D3948	Standard Test Method for Determining Water Separation Characteristics of Aviation Turbine Fuels by Portable Separometer
ASTM D4052	Standard Test Method for Density, Relative Density, and API Gravity of Liquids by Digital Density Meter
ASTM D4057	Standard Practice for Manual Sampling of Petroleum and Petroleum Products
ASTM D4171	Standard Specification for Fuel System Icing Inhibitors
ASTM D4177	Standard Practice for Automatic Sampling of Petroleum and Petroleum Products
ASTM D4294	Standard Test Method for Sulfur in Petroleum and Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy
ASTM D4529	Standard Test Method for Estimation of Net Heat of Combustion of Aviation Fuels
ASTM D4809	Standard Test Method for Heat of Combustion of Liquid Hydrocarbon Fuels by Bomb Calorimeter (Precision Method)
ASTM D4952	Standard Test Method for Qualitative Analysis for Active Sulfur Species in Fuels and Solvents (Doctor Test)
ASTM D5001	Standard Test Method for Measurement of Lubricity of Aviation Turbine Fuels by the Ball-on-Cylinder Lubricity Evaluator (BOCLE)
ASTM D5006	Standard Test Method for Measurement of Fuel System Icing Inhibitors (Ether Type) in Aviation Fuels
ASTM D5452	Standard Test Method for Particulate Contamination in Aviation Fuels by Laboratory Filtration
ASTM D5453	Standard Test Method for Determination of Total Sulfur in Light Hydrocarbons, Spark Ignition Engine Fuel, Diesel Engine Fuel, and Engine Oil by Ultraviolet Fluorescence
ASTM D5972	Standard Test Method for Freezing Point of Aviation Fuels (Automatic Phase Transition Method)
ASTM D6379	Standard Test Method for Determination of Aromatic Hydrocarbon Types in Aviation Fuels and Petroleum Distillates-High Performance Liquid Chromatography Method with Refractive Index Detection
ASTM D6751	Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels
ASTM D7039	Standard Test Method for Sulfur in Gasoline, Diesel Fuel, Jet Fuel, Kerosine, Biodiesel, Biodiesel Blends, and Gasoline-Ethanol Blends by Monochromatic Wavelength Dispersive X-ray Fluorescence Spectrometry
ASTM D7042	Standard Test Method for Dynamic Viscosity and Density of Liquids by Stabinger Viscometer (and the Calculation of Kinematic Viscosity)
ASTM D7224	Standard Test Method for Determining Water Separation Characteristics of Kerosine-Type Aviation Turbine Fuels Containing Additives by Portable Separometer

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ASTM D7566	Standard Specification for Aviation Turbine Fuel Containing Synthesized Hydrocarbons
ASTM D7797	Standard Test Method for Determination of the Fatty Acid Methyl Esters Content of Aviation Turbine Fuel Using Flow Analysis by Fourier Transform Infrared Spectroscopy — Rapid Screening Method
ASTM E29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications.

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